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New combinations and typification of Neotropical *Cosmioneis* species (Cosmioneidaceae)

CARLOS E. WETZEL [1]*, EUGENIA A. SAR[2,3], INÉS SUNESEN[2,3], BART VAN DE VIJVER[4,5] & LUC ECTOR[1]

[1]*Environmental Research and Innovation Department (ERIN), Luxembourg Institute of Science and Technology (LIST), Belvaux, Luxembourg*
[2]*División Ficología "Dr. Sebastián A Guarrera", Facultad de Ciencias Naturales y Museo, Universidad Nacional de la Plata, La Plata, Argentina*
[3]*Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), CCT-La Plata, La Plata, Argentina*
[4]*Department of Cryptogamy (Bryophyta & Thallophyta), Botanic Garden Meise, Meise, Belgium*
[5]*Department of Biology, University of Antwerp, ECOBE, Antwerpen, Wilrijk, Belgium*

The identity of *Navicula brasiliana* (Cleve) Cleve is here detailed based on analysis of the original slide from the Cleve & Möller collection. Additional observations with light and scanning electron microscopy of two later varieties described from the Neotropics are also provided: *N. brasiliana* var. *platensis* Frenguelli and *N. brasiliana* var. *guadalupensis* Manguin described from Argentina and Guadalupe (French Antilles), respectively. Based on the morphological characteristics of the frustules the three taxa belong to *Cosmioneis* D.G. Mann & Stickle. These rather rare taxa are usually reported from fresh to brackish water environments, including hot springs in the Neotropical and Paleotropical regions. While *N. brasiliana* var. *platensis* is widely recorded in several regions of the African continent and Argentina, *N. brasiliana* is often recorded in Central America, almost certainly because of uncertainty over their identities, to date based only on line drawings. We conclude that *Cosmioneis brasiliana* (Cleve) C.E. Wetzel & Ector *comb. nov.* is a distinct species, while *N. brasiliana* var. *guadalupensis* is a taxonomic synonym of *Cosmioneis platensis* (Frenguelli) C.E. Wetzel, E. Sar & Ector *comb. nov.*

Keywords: Cosmioneis, Navicula, *Cleve, Frenguelli, Manguin, lectotypification, type material, Bacillariophyta*

Introduction

The genus *Cosmioneis* D.G. Mann & Stickle in Round et al. (1990) was erected to accommodate species around *Navicula pusilla* W. Smith (1853: 52, pl. 17, fig. 145). The genus belongs to the family *Cosmioneidaceae* D.G. Mann in Round et al. (1990), order *Naviculales* Bessey emend D.G. Mann in Round et al. (1990). This is a small genus that includes solitary biraphid naviculoid diatoms with a lanceolate to elliptical outline and capitate to rostrate apices. Striae are radiate and uniseriate, composed of round to oval areolae. The striae are more widely spaced near the central area due to wider virgae. The axial area is narrow and linear, except at the central area where it is expanded and usually elliptical (Spaulding & Edlund 2008). Living cells contain usually two H-shaped plastids, one against each valve (Round et al. 1990) and the species are usually found in alkaline and subaerial habitats. Most of the species are found in coastal regions or brackish environments in addition to freshwater lakes and ponds (Witkowski et al. 2000).

Cosmioneis species were described within *Navicula* sensu lato in the late nineteenth and the first half of the twentieth centuries (i.e. by A. Grunow, W. Smith, P.T. Cleve, G. Krasske and F. Hustedt). The most recent contribution to the genus was provided by Lowe & Sherwood (2010), who described three new putative endemic species from aerial habitats in Hawai'i, and recently a new *Cosmioneis* taxon was observed on the Antarctic Deception Island (Zidarova et al. 2016). *Cosmioneis* currently includes 13 species listed in Table 1.

In the present work, we present observations on the original material of the three taxa (slides and raw material) collected and described from South America: *Navicula brasiliana* Cleve and two varieties from the Neotropics [i.e. *N. brasiliana* var. *platensis* Frenguelli in Frenguelli & Cordini (1937: 96) and *N. brasiliana* var. *guadalupensis* Manguin in Bourrelly & Manguin (1952: 66)]. The original collections of P.T. Cleve, J. Frenguelli and E. Manguin were also investigated to elucidate the identities of these taxa using light and scanning electron microscopy. A review of the literature concerning the discussed species and varieties is also provided.

Materials and methods

Morphological information was obtained from observations of the original materials (slides) using LM, while additional SEM images were made for *N. brasiliana* var.

*Corresponding author. E-mail: carlos.wetzel@list.lu
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Table 1. List of species currently placed in the genus *Cosmioneis* D.G.Mann & Stickle.

Species	References
***Cosmioneis brasiliana* (Cleve) C.E. Wetzel & Ector comb. nov.**	**This study**
Cosmioneis capitata (Hustedt 1937: 259, pl. 18, figs 13, 14) Lange-Bertalot in Metzeltin et al. (2005: 33)	Hustedt (1937) and Metzeltin et al. (2005)
Cosmioneis citriformis A.R. Sherwood & R.L. Lowe in Lowe & Sherwood (2010: 23, figs 10–18)	Lowe & Sherwood (2010)
Cosmioneis delawarensis (Grunow in Cleve & Möller 1879a: No. 211) D.G. Mann in Round et al. (1990: 666)	Cleve & Möller (1879a) and Round et al. (1990)
Cosmioneis eta (Cleve 1893: 13, pl. 1, fig. 5) Witkowski et al. (2000: 176)	Cleve (1893) and Witkowski et al. (2000)
Cosmioneis grossepunctata (Hustedt 1944: 271, fig. 1) D.G. Mann in Round et al. (1990: 666)	Hustedt (1944) and Round et al. (1990)
Cosmioneis hawaiiensis R.L. Lowe & A.R. Sherwood (2010: 24, figs 19–24)	Lowe & Sherwood (2010)
Cosmioneis incognita (Krasske 1932: 112–113, fig. 14) Lange-Bertalot in Werum & Lange-Bertalot (2004: 134)	Krasske (1932) and Werum & Lange-Bertalot (2004)
Cosmioneis lundstroemii (Cleve in Cleve & Grunow 1880: 13, pl. 2, fig. 39) D.G. Mann in Round et al. (1990: 666)	Cleve & Grunow (1880) and Round et al. (1990)
***Cosmioneis platensis* (Frenguelli) C.E. Wetzel, E. Sar & Ector comb. nov.**	**This study**
Cosmioneis pusilla (W. Smith 1853: 52, pl. 17, fig. 145) D.G. Mann & Stickle in Round et al. (1990: 666).	Smith (1853) and Round et al. (1990)
Cosmioneis regigeorgiensis Zidarova et al. (2016: 42–43, figs 35–45)	Zidarova et al. (2016)
Cosmioneis reimeri R.L. Lowe & A.R. Sherwood (2010: 22, figs 1–9).	Lowe & Sherwood (2010)

platensis Frenguelli and *N. brasiliana* var. *guadalupensis* Manguin, as detailed below:

Slide n° 193 (BR!) with *Cymbella* (?) *brasiliana* Cleve from Cleve & Möller (1879a) from Brazil ('Brazil, fresh water, collected by Dr. E. Warming'), was deposited in the Van Heurck Collection at the Botanic Garden Meise, Belgium (BR). The slide was analysed using an Olympus BX53 microscope, equipped with Differential Interference Contrast (Nomarski), and an Olympus® UC30 camera (Figs 1–15).

Series 309, Slide n° 5 (LPC!) with *N. brasiliana* var. *platensis* Frenguelli, was deposited at the Herbarium of the División Ficología 'Dr. Sebastián A. Guarrera' (LPC), Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Argentina. According to Frenguelli & Cordini (1937: 82), '*cuatro de las muestras B (series n° 307 a 310) proceden del perfil de la zanja a lo largo del camino de Quilino a San Pedro Norte*', Córdoba, Argentina (Figs 17–23). The slide was analysed using a Leica® DM 2500 (phase contrast and differential interference contrast). Raw material from sample n° 309 was prepared for SEM observations with a Jeol® JSM 6360 LV (Figs 24–28).

Slide AD7747 (P!) with *N. brasiliana* var. *guadalupensis* Manguin, deposited at the Museum National d'Histoire Naturelle, Paris (P) (Figs 29–36). Guadeloupe. Basse-Terre. '*Source chaude de 'Bouillante', située au niveau de la mer, dans le secteur pierreux et aride du littoral occidental, 'sous le vent'; pluviométrie : 1 m.50 par an; eau à salinité forte, à température de 50–60° au point de jaillissement (11 12/36)*', slide from Sample n° 24, leg. P. Allorge was analysed with a Leica® DMRD microscope. A small portion of the raw material was prepared for SEM observations with a Hitachi® SU-70 field emission scanning electron microscope (Figs 37–42).

The original drawings from important historical literature records of the species were searched and are summarized in Figs 43–52. A worldwide distribution map was produced based on the published literature (Fig. 53).

Results and discussion

Cosmioneis brasiliana (Cleve) C.E. Wetzel & Ector comb. nov.

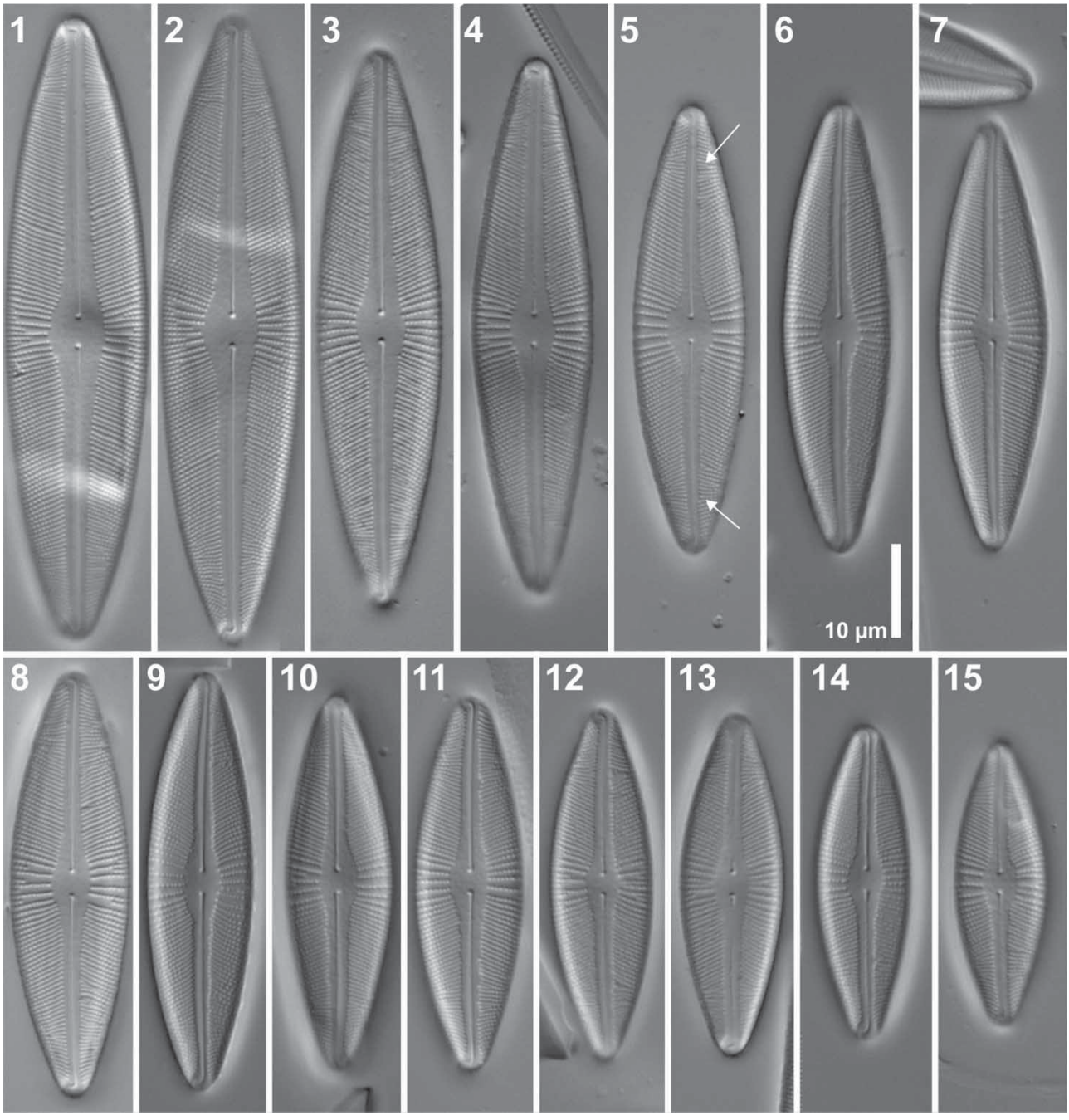
Figs 1–15

Basionym: *Cymbella brasiliana* Cleve 1881. *Kongliga Svenska-Vetenskaps Akademiens Handlingar* 18: 4, pl. 1, fig. 4.

Homotypic synonyms: '*Cymbella* (?) *brasiliana*' Cleve in Cleve & Möller (1879a: slide n° 177, *nomen nudum*); '*Cymbella* (?) *brasiliana*' Cleve in Cleve & Möller (1879a: slide n° 193, *nomen nudum*); *Navicula brasiliana* (Cleve) Cleve (1894: 139); *Naviculadicta brasiliana* (Cleve) Metzeltin & Lange-Bertalot (1998: 144) *invalid comb*.

Heterotypic synonyms: *Navicula brasiliana* Grunow in Cleve & Möller (1879b: slide n° 257, *nomen nudum*); *Schizonema brasilianum* (Grunow) Kuntze (1898: 552).

Lectotype (designated here): Slide n° 193 ('Brazil') in Cleve & Möller collection in the Botanic Garden Meise, Belgium (BR!).



Figures 1–15. *Cosmioneis brasiliana* (Cleve) C.E. Wetzel & Ector *comb. nov.* LM images from slide n° 193 (Brazil) from the Cleve & Möller Collection (BR!).

Type locality: 'BRAZIL. Freshwater, collected by Dr. Warming' (Cleve & Möll. Diat. Coll. Slide n° 193). Since no precise indication is given in the annotations to the Cleve & Möller collection (Bart Van de Vijver, pers. comm.), it is probable that the material studied by Cleve comes from the State of Minas Gerais (Brazil), close to 'Lagoa Santa' 37 km north-northeast of Belo Horizonte (MG), where Dr. E. Warming (Johannes Eugenius Bülow Warming) lived and worked intensively on his monograph about the ecology of tropical plant communities, including aquatic plants of the Podostemataceae family (Warming 1892).

Remarks: Material from slide n° 193 in the Cleve & Möller collection has specimens with wide, lanceolate to rhombic-lanceolate valves (in smaller specimens), with rounded apices (Figs 1–15); length 29.0–71.0 µm, width 9.0–17.0 µm. The axial area is linear, widening towards the

Table 2. Literature records of *N. brasiliana* and its varieties, ordered by year of publication. Bold records are materials analysed in this study.

Year	Author	Reported as	Continent	Country	Sample/Locality/Habitat	Illustr.
1879a	**Cleve & Möller**	***Cymbella* (?) *brasiliana***	**South America**	**Brazil**	Sample 177, **Sample 193**	
1879b	Cleve & Möller	*Navicula brasiliana*	North America	USA	Sample 257	
1881	**Cleve**	***Cymbella brasiliana***	**South America**	**Brazil**	**Sample 193**	**drawing**
1894	Cleve	*Navicula brasiliana*	North America	USA	California (Santa Rosa; Grove coll.)	
1894	Cleve	*Navicula brasiliana*	South America	Brazil	Sample 193	
1894	Cleve	*Navicula brasiliana*	South America	Ecuador	Springs in Tesalia (Prov Pichincha)	
1937	**Frenguelli & Cordini**	***Navicula brasiliana* var. *platensis***	**South America**	**Argentina**	**Quilino, Córdoba**	**drawing**
1949	Hustedt	*Navicula brasiliana* var. *platensis*	Africa	Congo	Lake Kibuga, Uganda	drawing
1952	**Bourrelly & Manguin**	***Navicula brasiliana* var. *guadalupensis***	**Central America**	**Guadaloupe**	**Warm spring (50–60°C)**	**drawing**
1954	Guermeur	*Navicula brasiliana* var. *platensis*	Africa	Senegal	Lac Tamna	drawing
1963	Cholnoky	*Navicula platensis*	Africa	Namibia	Windhoek deposits	drawing
1964	Hustedt	*Navicula brasiliana* f. *platensis*	Europe	not specified	not specified	drawing
1966	Cholnoky	*Navicula platensis*	Africa	Namibia	Several sources and localities in Namibia	drawing
1967	Compère	*Navicula brasiliana* var. *platensis*	Africa	Tchad	Ounianga Kebir (Lac Katam and Yoam)	drawing
1969	Iltis	*Navicula brasiliana* var. *platensis*	Africa	Tchad	Kanem region	
1972	Iltis	*Navicula brasiliana* var. *platensis*	Africa	Tchad	Kanem region	
1976	Selva	*Navicula platensis*	North America	USA	Tertiary freshwater deposits from Ogallala, Kansas	LM
1986	Krammer & Lange-Bertalot	*Navicula brasiliana*	Europe	not specified	not specified	LM
1988	Compère & Delmotte	*Navicula brasiliana* var. *platensis*	Africa	Zambia	Hot springs at Kafue polder (Itezhi-Tezhi)	
1989	Maidana & Herbst	*Navicula brasiliana* var. *platensis*	South America	Argentina	Santiago del Estero (Salado River)	
1994	Maidana & Herbst	*Navicula platensis*	South America	Argentina	Province of Chaco (three localities)	
1994	Vinocur et al.	*Navicula platensis*	South America	Argentina	Salado River Basin (Buenos Aires Province)	drawing
1998	Metzeltin & Lange-Bertalot	*Naviculadicta brasiliana*	North America	Mexico	Yucatan, Cobá Lake	LM
1999	Cooper et al.	*Navicula brasiliana*	North America	USA	Florida Everglades	
2000	Slate & Stevenson	*Navicula brasiliana*	North America	USA	Florida Everglades	
2001	Blinn & Bailey	*Navicula brasiliana*	Australia	Australia	Diatom communities from saline streams	
2005	Resende et al.	*Navicula brasiliana*	Europe	Portugal	Ria de Aveiro	
2005	Vélez et al.	*Navicula brasiliana*	South America	Colombia	Patía Valley, subfossil	
2007	Metzeltin & Lange-Bertalot	*Navicula brasiliana* var. *guadalupensis*	Central America	Guadaloupe	Type material from Manguin	LM
2009	Comas González	*Navicula brasiliana*	Central America	Cuba	Three localities in Cuba	
2010	López Fuerte	*Navicula brasiliana*	North America	Mexico	Baja California Sur	LM
2010	La Hee	*Naviculadicta brasiliana*	Central America	Belize	New River Lagoon (Orange Walk)	
2011	Sosa et al.	*Navicula brasiliana*	South America	Argentina	Chucul (Córdoba)	
2012	Winsborough et al.	*Navicula brasiliana*	South America	Peru	Pachacamac, Urpi Kocha Lagoon	

(*Continued*).

Table 2. Continued.

Year	Author	Reported as	Continent	Country	Sample/Locality/Habitat	Illustr.
2012	Novelo	*Naviculadicta brasiliana*	North America	Mexico	Valle de Tehuacán-Cuicatlán	drawing
2012	Santos et al.	*Navicula brasiliana* var. *guadalupensis*	South America	Brazil	Saline lakes in Pantanal	LM
2013	Bramburger et al.	*Navicula brasiliana*	North America	USA	Everglades National Park	
2013	Hassan	*Navicula brasiliana* var. *platensis*	South America	Argentina	Lake Lonkoy, southern Pampas	LM
2015	Buendía-Flores et al.	*Naviculadicta brasiliana*	North America	Mexico	Brackish environments of Xochimilco-Tláhuac	LM

centre to form a linear-elliptical central area. The latter is bordered by less densely spaced striae of variable length. Raphe branches are lateral, slightly undulate, with prominent, slightly curved proximal endings. External distal raphe endings are hooked in the same direction, sometimes giving a slight 'cymbelloid' aspect to the valve. Punctate striae are strongly radiate throughout most of the valve, becoming strongly convergent towards the apices with a marked shift in the orientation (Fig. 5). The stria density is 20–23 in 10 µm towards the apices, while it is significantly less in the central portion, ca. 13–16 in 10 µm. *Cosmioneis brasiliana* shows similarities with *Cosmioneis reimeri* R.L. Lowe & A.R. Sherwood (2010), which has more strongly punctate areolae, does not have shorter striae in the central area and has drop-like proximal raphe ends, which in *C. brasiliana* are clearly deflected. *Cosmioneis reimeri* also shows wider spacing between the areolae towards the valve margins (giving a stronger 'punctate' impression), a feature not observed in our SEM images.

Distribution and ecology: This taxon is rarely mentioned in the literature, with a few records from Cleve himself (in Cleve & Möller 1879a, b), on slides n° 177 and 193, reporting it from Brazil, Ecuador and the USA (Cleve 1881, 1894). The first drawing and complete description was given by Cleve (1881, pl. 1, figs 4a, b) as *Cymbella brasiliana* in a material from Brazil (see Table 2). Almost 100 years later, one valve from an (unspecified) original slide was illustrated with LM by Krammer & Lange-Bertalot (1986: 166, pl. 52, figs 1–2). To date this is the only LM illustration provided for this species and agrees well with the line drawings made by Cleve (1881, here as Fig. 43). Metzeltin & Lange-Bertalot (1998: 144, pl. 93, figs 5–7) illustrated the species as '*Navicula(dicta) brasiliana* Cleve' based on samples from Guyana (Essequibo River) and Mexico (Yucatán, Cobá Lake), making these the only available micrographs of the taxon. Recently, the name has been applied by researchers working on modern and subfossil material from the Florida Everglades, USA (Cooper et al. 1999, Slate & Stevenson 2000, Bramburger et al. 2013), to subfossil material in Colombian lakes from South America (Vélez et al. 2005) and from freshwater material from Central America (Cuba) by Comas González (2009). The records from Europe (e.g. Ria de Aveiro, Portugal, Resende et al. 2005) and Australia (Blinn & Bailey 2001) are outliers in a distribution that is predominantly Neotropical, with additional records from Argentina (Sosa et al. 2011), Belize (La Hee 2010), Brazil (Santos et al. 2012) Mexico (López Fuerte 2010, Novelo 2012, Buendía-Flores et al. 2015) and Peru (Winsborough et al. 2012). In general, most records indicate fresh to brackish waters, and slightly alkaline environments (Table 2).

***Cosmioneis platensis* (Frenguelli) C.E. Wetzel, E. Sar & Ector comb. nov.**

Figs 16–28

Basionym: *Navicula brasiliana* var. *platensis* Frenguelli in Frenguelli & Cordini (1937), *Revista del Museo de La Plata (n. s.)* 1, *Sección Geología* 2: 96, pl. 104, fig. 9–C.

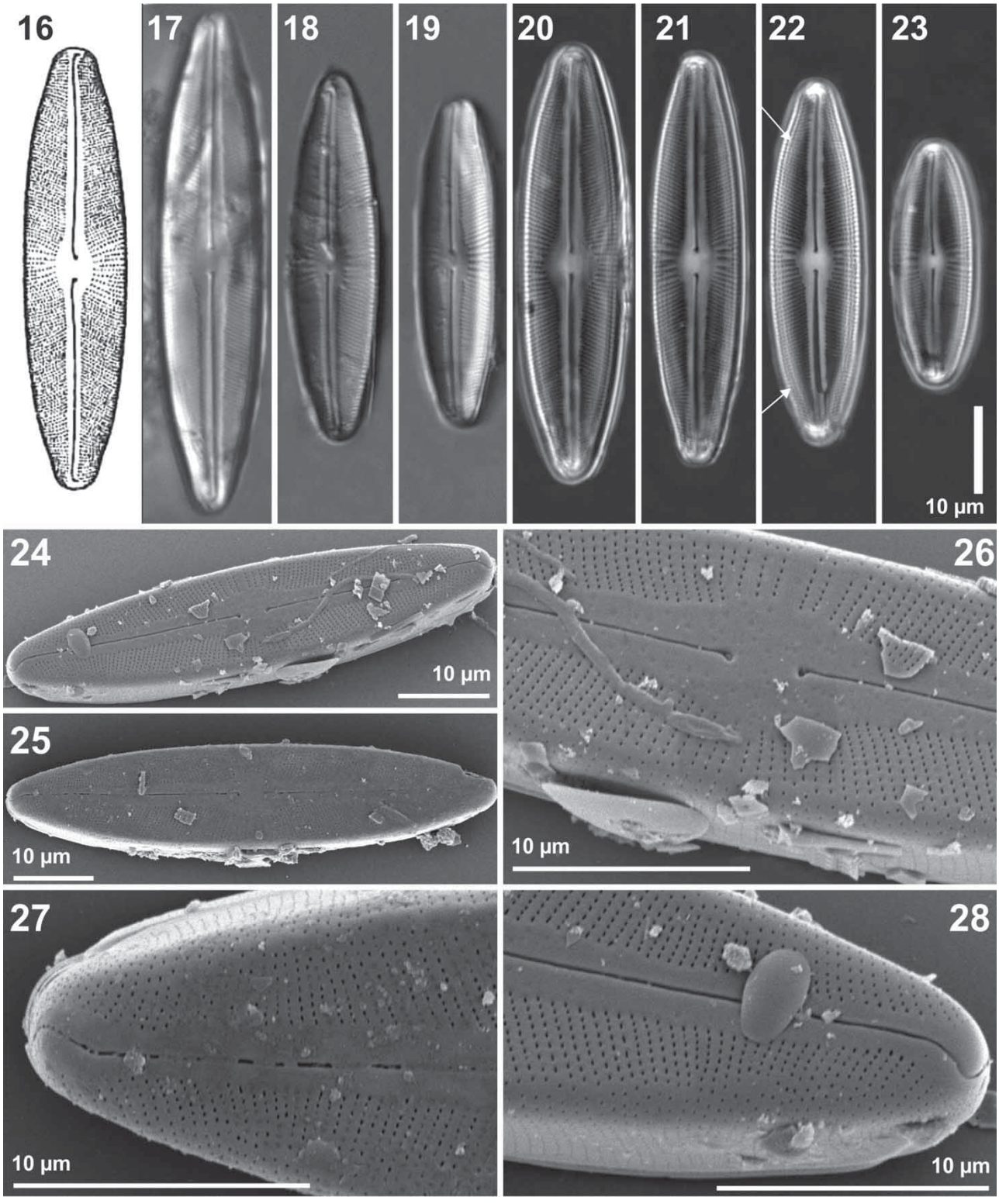
Homotypic synonyms: *Navicula platensis* (Frenguelli) Cholnoky (1963: 34); *Navicula brasiliana* f. *platensis* (Frenguelli) Hustedt (1964: 764).

Heterotypic synonym: *Navicula brasiliana* var. *guadalupensis* Manguin in Bourrelly & Manguin (1952: 66, pl. 4, fig. 85) (P!).

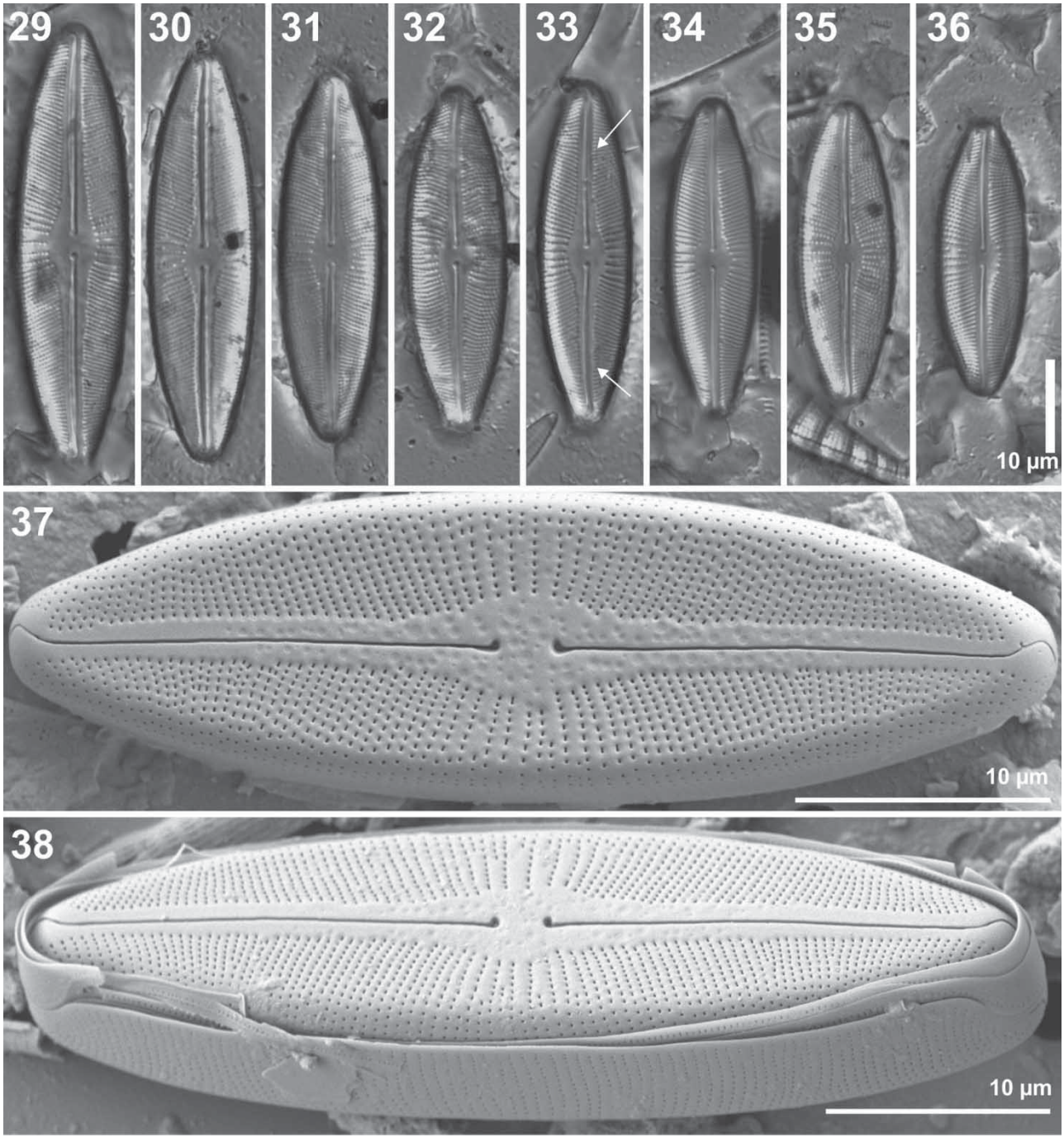
Lectotype (designated here): Series 309, slide n° 5 (LPC!) with *N. brasiliana* var. *platensis* Frenguelli, deposited at the Herbarium of the División Ficología 'Dr. Sebastián A. Guarrera' (LPC), Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata.

Type locality: Argentina. Córdoba. San-Nicolás, Los Ríos.

Remarks: Material from series 309 slide n°5 in the Frenguelli Collection (LPC!) has specimens with lanceolate to linear-lanceolate valves in smaller specimens, with broadly rounded apices (Figs 17–23). Frenguelli in Frenguelli & Cordini (1937, fig. 9C) described the variety *platensis* (partially reproduced in Fig. 16) based on differences in the valve outline, linear-elliptic with more or less attenuated, broadly rounded apices ('*contorno lineal-elíptico,con extremos más o menos atenuados y ampliamente redondeados*'). Frenguelli also mentioned possible



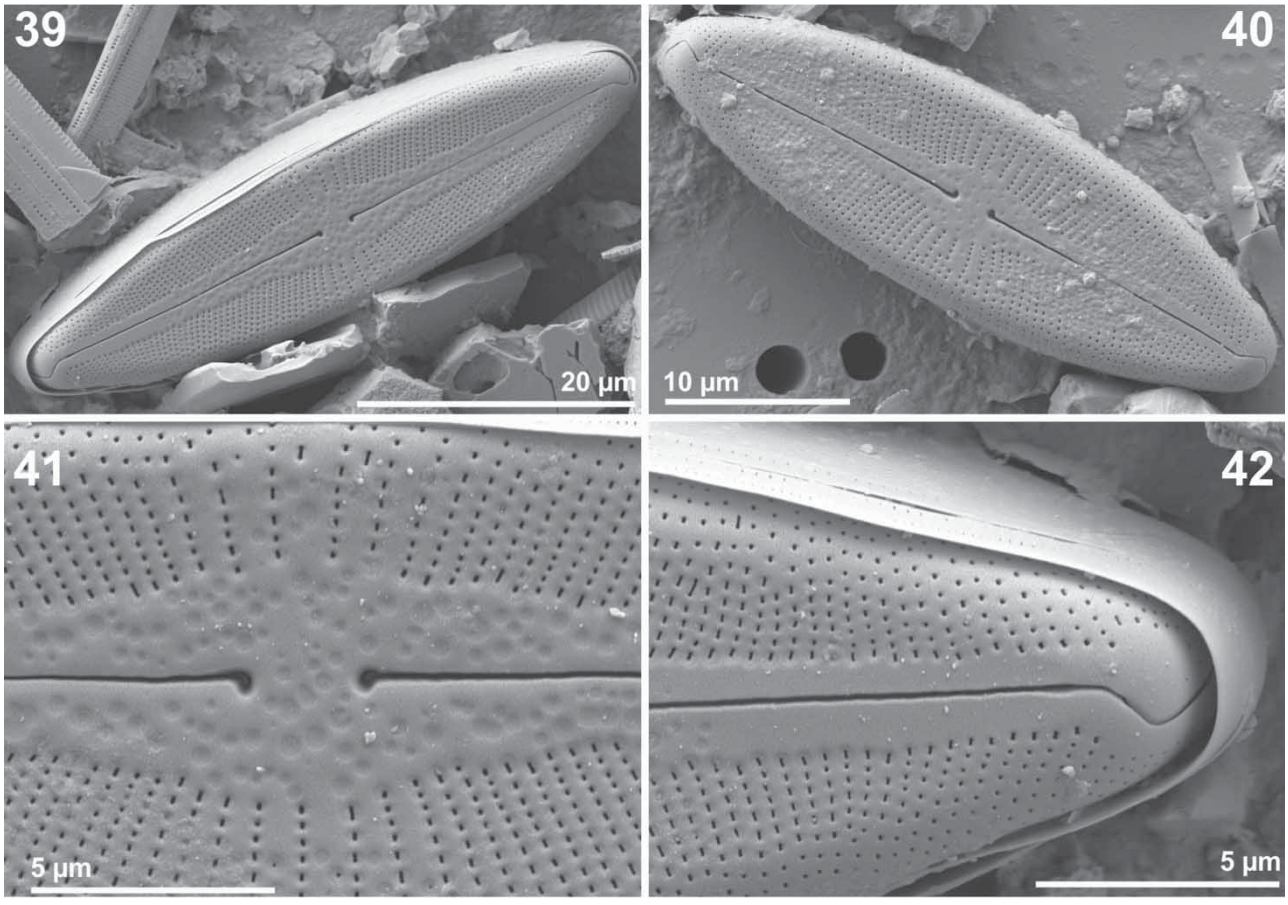
Figures 16–28. *Cosmioneis platensis* (Frenguelli) C.E. Wetzel, E. Sar & Ector *comb. nov.* **Fig. 16**. Reproduction of *N. brasiliana* var. *platensis* Frenguelli in Frenguelli & Cordini (1937, pl. 104, fig. 9-C). **Figs 17–23**. LM images from the original slide n° 5 (series 309) (LPC!) of *N. brasiliana* var. *platensis* Frenguelli (Córdoba, Argentina). **Figs 24–28**. SEM images from sample n°309 showing overall valve shape and stria density. Proximal raphe ends slightly curved (**Fig. 26**). Detail of apices showing the divergence of striae orientation (**Figs 27–28**).



Figures 29–38. *N. brasiliana* var. *guadalupensis* Manguin [= *Cosmioneis platensis* (Frenguelli) C.E. Wetzel, E. Sar & Ector *comb. nov.*]. **Figs 29–36**. LM images from the original slide AD7747 (P). **Figs 37–38**. SEMs of the original material (sample n° 24, Basse-Terre, Guadeloupe) showing the external aspects of the valve face and mantle.

confusion with the Holarctic species *Navicula lundstroemii* Cleve [≡ *Cosmioneis lundstroemii* described from Jamal (i.e. Yamal Peninsula, Siberia, Russia) and illustrated from Silver Springs, Florida (USA) by Hohn (1961) (reproduced as Fig. 48)]. *Cosmioneis lundstroemii* was considered a synonym of *Cymbella frieseana* Cleve (1881: 5) by Krammer & Lange-Bertalot (1986, pl. 57, fig. 10) who illustrated the species from the slide N5-05 in Hustedt Collection (BRM), from Finland (Henriksberg, Sandstrand). The specimen illustrated by Krammer & Lange-Bertalot (1986) clearly belongs to a different species, with strongly rostrate apices and denser striae.

The population on series 309 slide n° 5 (Figs 17–23) matches the drawing provided by Frenguelli (Frenguelli

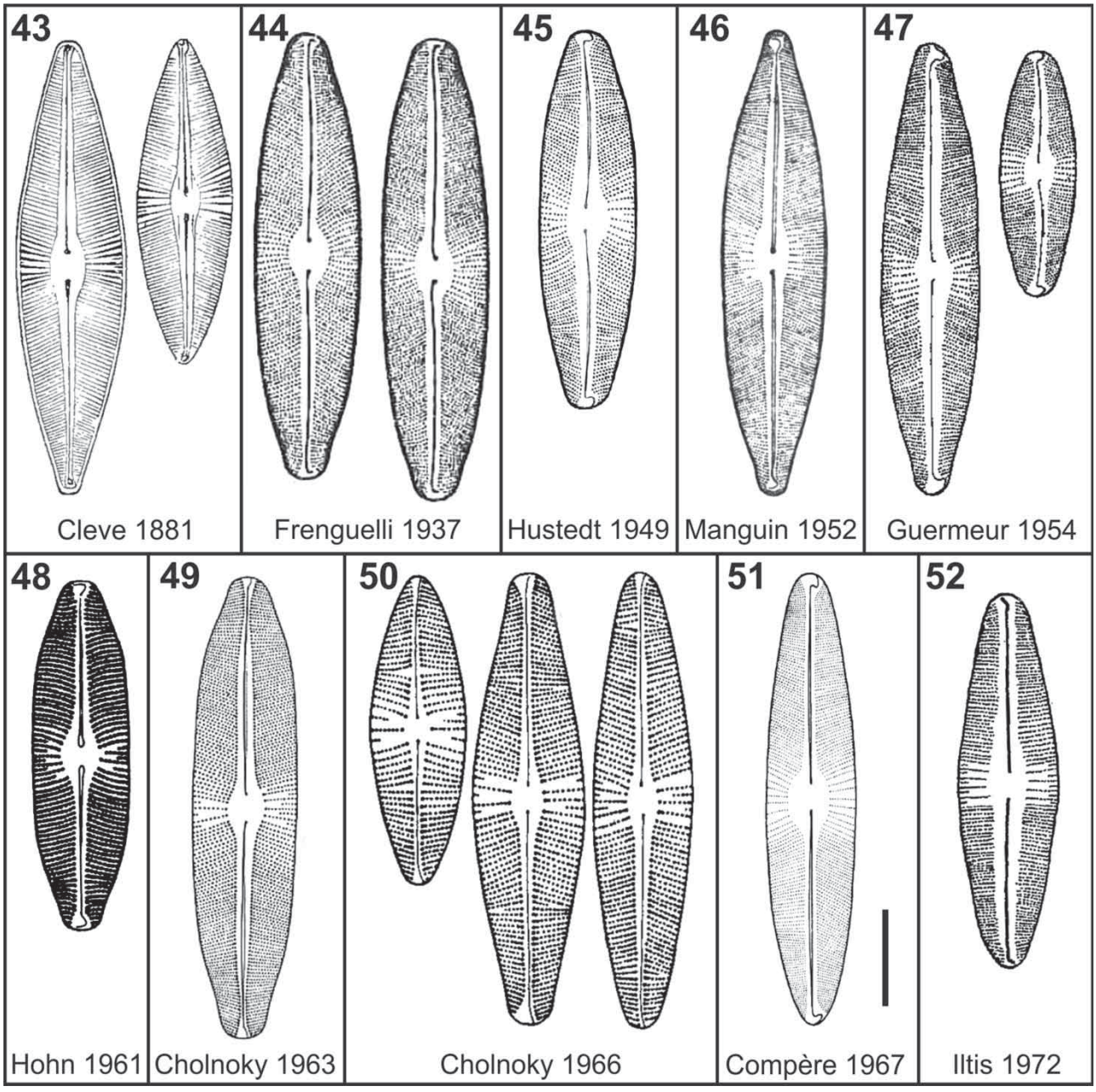


Figures 39–42. SEM details of *N. brasiliana* var. *guadalupensis* Manguin [= *Cosmioneis platensis* (Frenguelli) C.E. Wetzel, E. Sar & Ector *comb. nov.*] from the original material (sample n° 24, Basse-Terre, Guadeloupe).

& Cordini, 1937, fig. 9C) and shows specimens with subrostrate apices, unlike *N. brasiliana,* even though morphometric measures do not completely differentiate the species (Table 3). As in *N. brasiliana*, the striation pattern changes from radial to convergent near the apices (Fig. 22). SEM images from the same sample show slightly curved proximal raphe ends (Fig. 26). Details of apices show the shift in stria orientation (Figs 22, 27–28). Although described from relatively distant localities, we could not find consistent differences between the material described by Frenguelli from that described by Manguin (Figs 29–38) as variety *guadalupensis*. Valve shape, stria orientation and morphometric characters do not allow separation of the two varieties (Table 3), and for this reason we treat both as synonymous. Since Frenguelli's variety was described 15 years earlier, it has nomenclatural priority.

Distribution and ecology: After the original description of the variety *platensis* by Frenguelli in Frenguelli & Cordini (1937) in the Quilino region (Córdoba, Argentina), Hustedt (1949) was the first to make a formal record of it from material collected in Lake Kibuga (Congo, reproduced as Fig. 45). This taxon was subsequently extensively recorded from other African samples, from Namibia, Senegal, Chad and Zambia, always associated with individual sources and springs, either shown by hand drawings or simply reported in checklists (e.g. Guermeur 1954, Cholnoky 1963, 1966, Compère 1967, Iltis 1969, 1972, Compère & Delmotte 1988). Cholnoky (1963) raised the variety to species rank. Despite being illustrated in Hustedt (1964), in a volume dealing with European diatoms (no precise location is given), the species was never recorded from European samples. It is treated in Krammer & Lange-Bertalot (1986), although again without a precise locality. Selva (1976) recorded *Navicula platensis* from Tertiary freshwater deposits of Ogallala, Kansas (USA), while additional records from Argentina (South America) complement the occurrence of the species in the Salado River, Buenos Aires Province (Maidana & Herbst 1989, Vinocur et al. 1994), the Chaco Province (Maidana & Herbst 1994) and Lake Lonkoy, southern Pampas (Hassan 2013), the last with LM illustrations (see Table 2 for details on illustrations of the taxa).

The species is usually associated with fresh to brackish environments in subfossil and modern records. Frenguelli & Cordini (1937) already noted its accompanying floristic elements ('elementos accesorios'), the dominant ones being *Rhopalodia gibberula* var. *argentina* (Brun in Brun



Figures 43–52. Original drawings from several taxonomic works from tropical regions. **Fig. 43**. *N. brasiliana* Cleve [Brazil]. **Fig. 44**. *N. brasiliana* var. *platensis* Frenguelli in Frenguelli & Cordini [Argentina]. **Fig. 45**. *N. brasiliana* var. *platensis* Frenguelli sensu Hustedt [Congo]. **Fig. 46**. *N. brasiliana* var. *guadalupensis* Manguin [Guadalupe]. **Fig. 47**. *N. brasiliana* var. *platensis* Frenguelli sensu Guermeur [Senegal]. **Fig. 48**. *N. lundstroemii* Cleve & Grunow sensu Hohn [USA]. **Fig. 49**: *N. platensis* (Frenguelli) Cholnoky [Namibia]. **Fig. 50**. *N. platensis* sensu Cholnoky [Namibia]. **Fig. 51**: *N. brasiliana* var. *platensis* Frenguelli sensu Compère [Chad]. **Fig. 52**. *N. brasiliana* var. *platensis* sensu Iltis [Chad].

& Tempère) Frenguelli (1923: 76) and *Denticula valida* (Pedicino) Grunow in Van Heurck (1881, pl. 49, fig. 5).

Conclusions

The large external proximal raphe ends and coarse areolae exclude these taxa from *Navicula* Bory (1822) sensu stricto. Based on their morphology, these species should be assigned to *Cosmioneis*, thus increasing the number of *Cosmioneis* species from 10 to 12. After analysis of original material collected in South America, we conclude that *C. brasiliana* is a distinct species, while *N. brasiliana* var. *guadalupensis* is a taxonomic synonym of *C. platensis*.

It is interesting to note that, of the known *Cosmioneis* species, five are from the Holarctic region (i.e. *C. delawarensis*, *C. eta, C. incognita, C. lundstroemii* and *C. pusilla*), with most records originating from marine and coastal areas (see Witkowski et al. 2000). The diversity in

Table 3. Morphometric measurements (from the protologue) of the three taxa as well as LM measures made on the original slides in the present study.

	Cosmioneis brasiliana *comb. nov.*		*Cosmioneis platensis* *comb. nov.*		*Navicula brasiliana* var. *guadalupensis*	
Reference	Cleve (1881)	Present study	Frenguelli & Cordini (1937)	Present study	Bourrelly & Manguin (1952)	Present study
Length (µm)	35–65	29–71	39–96	28–57	32.5–54	28–47
Width (µm)	12–18	9–17	13–18	10–14	11–13	10–13
Striae in 10 µm (central)	not given	13–16	16–17	15–17	not given	15–18
Striae in 10 µm (apices)	22	20–23	20–21	20–22	25	21–24
Valve outline	Lanceolate, wide	–	Linear-lanceolate	–	Linear-lanceolate	–
Apices	Acuneate	–	Sub-rostrate	–	Sub-rostrate	–

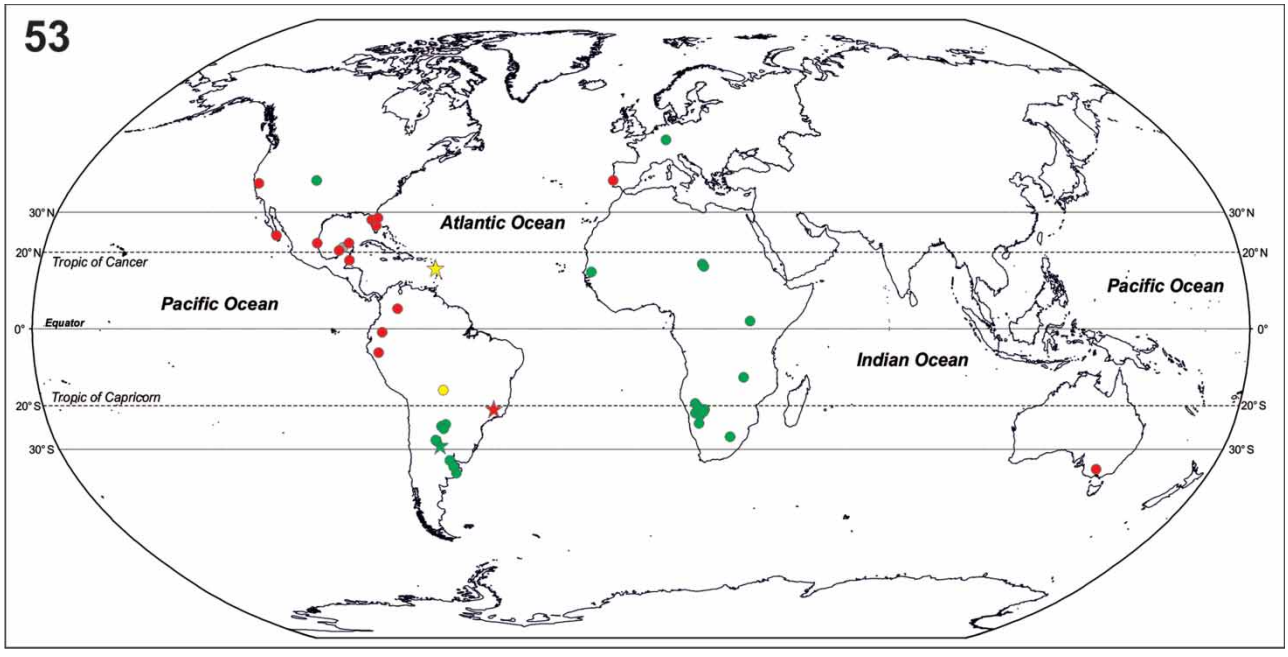


Fig 53. World distribution records of *Cosmioneis brasiliana* (red), *Cosmioneis platensis* (green) and *N. brasiliana* var. *guadalupensis* (yellow) (= *Cosmioneis platensis*). Star = type locality; circle = literature records (for more details see Table 2).

continental waters seems to be higher in tropical regions, including South America (*C. brasiliana*, *C. platensis*), Africa (*C. grossepunctata*), Southeast Asia (*C. capitata*) and the putative endemics from Hawai'i (*C. citriformis, C. hawaiiensis* and *C. reimeri*). Two species have been found in the sub-Antarctic and Maritime Antarctic regions. A fairly large population of *C. grossepunctata* was observed in the soil of a small cavern, more than 1 km from the coast (Van de Vijver et al. 2002). A second, so far undescribed *Cosmioneis* was found in a coastal sample on Deception Island in the southern Atlantic Ocean (Zidarova et al. unpubl.).

The great majority of available literature records of *C. brasiliana* sensu lato and its varieties indicate that these taxa are mainly present in tropical regions (Fig. 53). The bibliographic trend to use the name *N. platensis* on the African continent is probably due to the early works of Hustedt and Cholnoky. To date, there are no LM or SEM illustrations from this species complex in Africa to compare with our specimens. Further studies on the African continent would clarify the distribution of these taxa.

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ORCID
Carlos E. Wetzel http://orcid.org/0000-0001-5330-0494

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